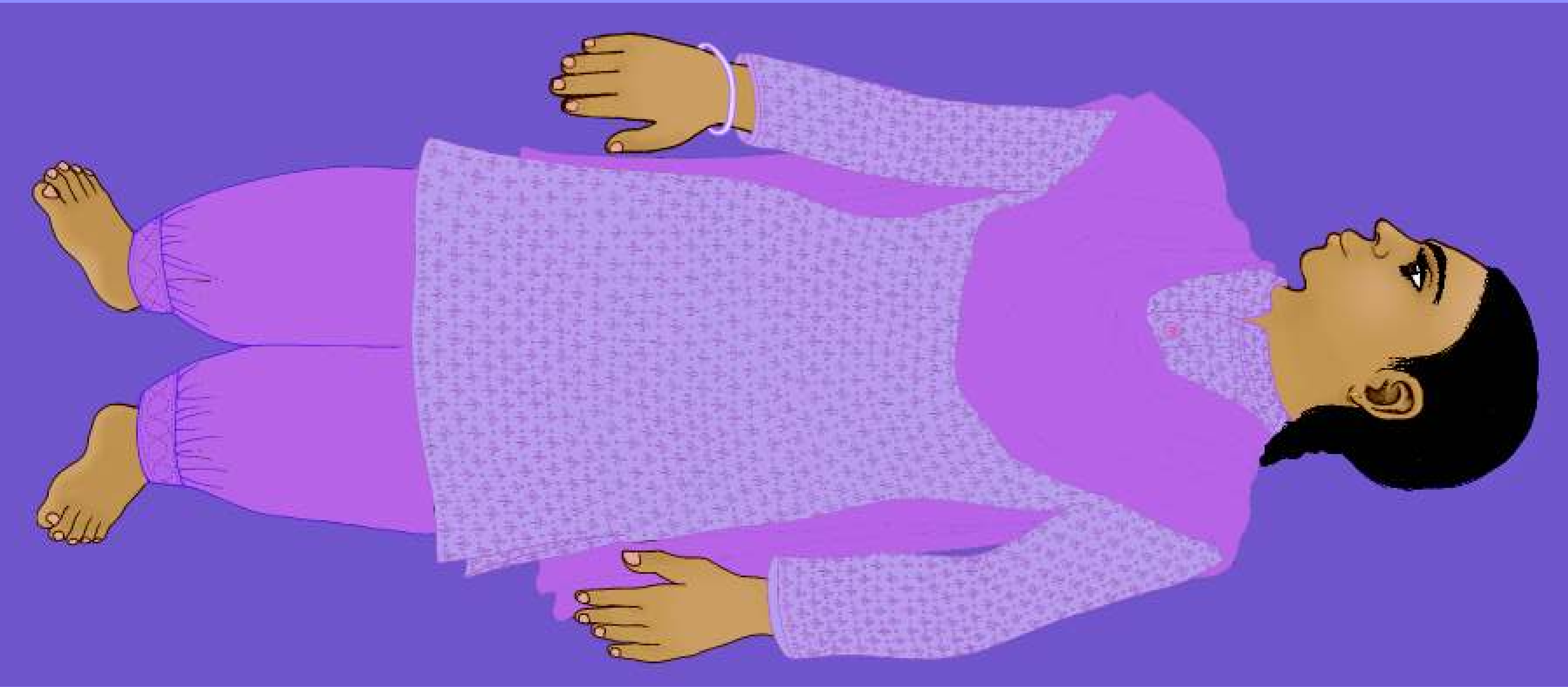


HUMAN BODY SYSTEMS

INTRODUCTION

Who are we?

We can learn the answer to this question by observing, hypothesizing, experimenting, and analysing. We are complex living beings in a complex, contradictory, ever-changing world. We know that we do not understand everything about ourselves, but by using this scientific method we can keep learning more and more.

Without our bodies we are nothing. A person cannot exist without a body. In this book you can see pictures of some basic structures of the human body. You can also begin to see the interconnections between the different parts of the body in order to understand how the body functions.

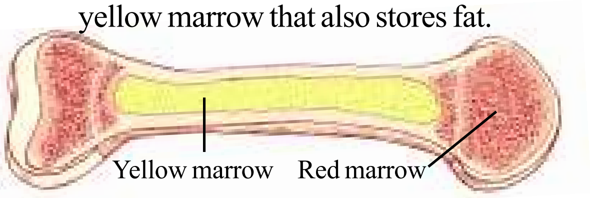
We should warn you that there are two serious misconceptions that you may get from this book. One misconception is that any part of the human body exists in a static state. Actually everything in the body is in a constant state of movement and change. It is constantly being broken down and rebuilt. Every thing is in the process of becoming something else. Actually, we are not made of things, but of processes. Thus, on the left-hand pages, we have briefly discussed some of the processes and functions of the structures seen on the right-hand pages.

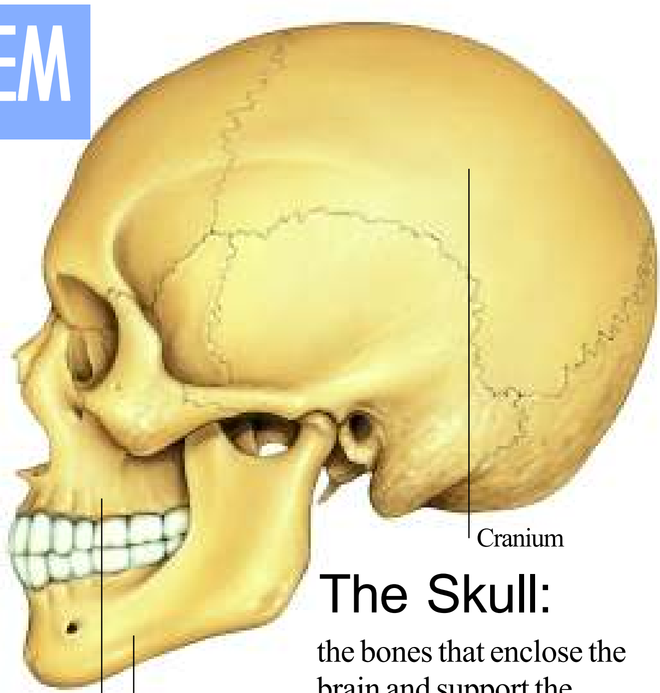
The second misconception is that the human body systems exist as separate entities. They cannot function separately. They are all interconnected and dependent on each other. Some of the same organs even belong to more than one system. For example, the long bones appear in both the skeletal and the lymphatic systems, since in addition to providing support they also manufacture blood cells. The ovaries appear in both the hormonal and the reproductive systems, since they produce both hormones and ova. These human body systems are merely useful ways of classifying and studying the structure and function of the body. All together they function and interact with each other and with the surroundings to produce a conscious, living human being.

CONTENTS

1 OUR SKELETAL SYSTEM

Our skeleton consists of all our bones, teeth, cartilage, and joints. Some bones protect our internal organs. Some bones provide a framework for the body (just as the spokes of an umbrella provide a framework). Some bones contain red marrow that produces blood cells and yellow marrow that also stores fat.



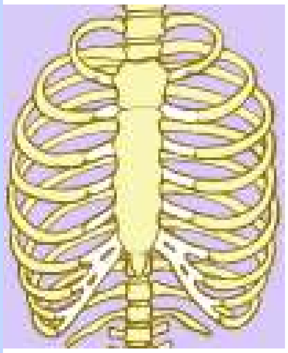


The Skull:

the bones that enclose the brain and support the face and teeth

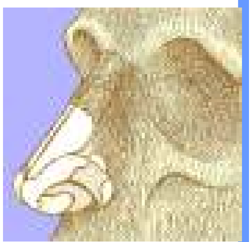
Cartilage

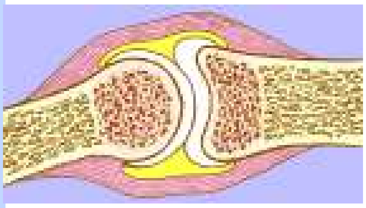
Cartilage is softer than bones and is somewhat flexible, like rubber.



Cartilage (shown here in white) connects the ribs to the sternum, allowing the ribs to move as we breathe.

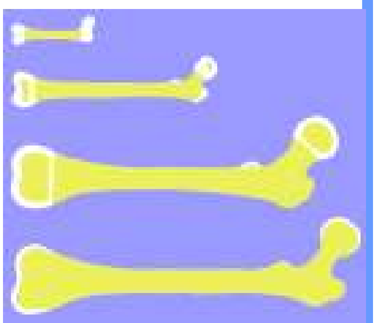
Cartilage supports our nose and outer ears.





Joints contain some cartillage.

birth
4 years
13 years
adult



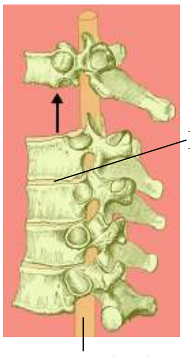
Much of an infant's skeleton consists of cartillage, which is gradually replaced by bone.

The Backbone

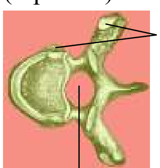
(the spinal column)

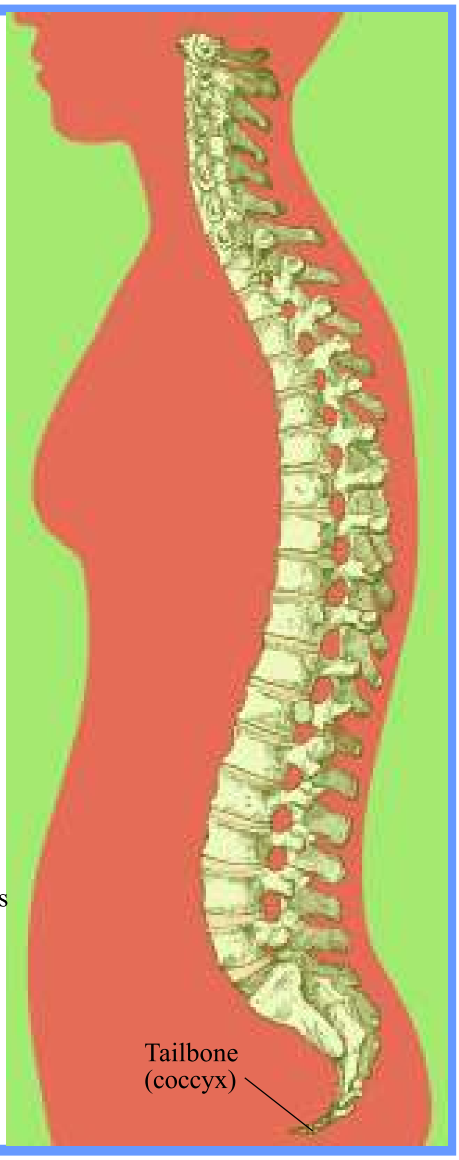
The backbone is made of vertebrae

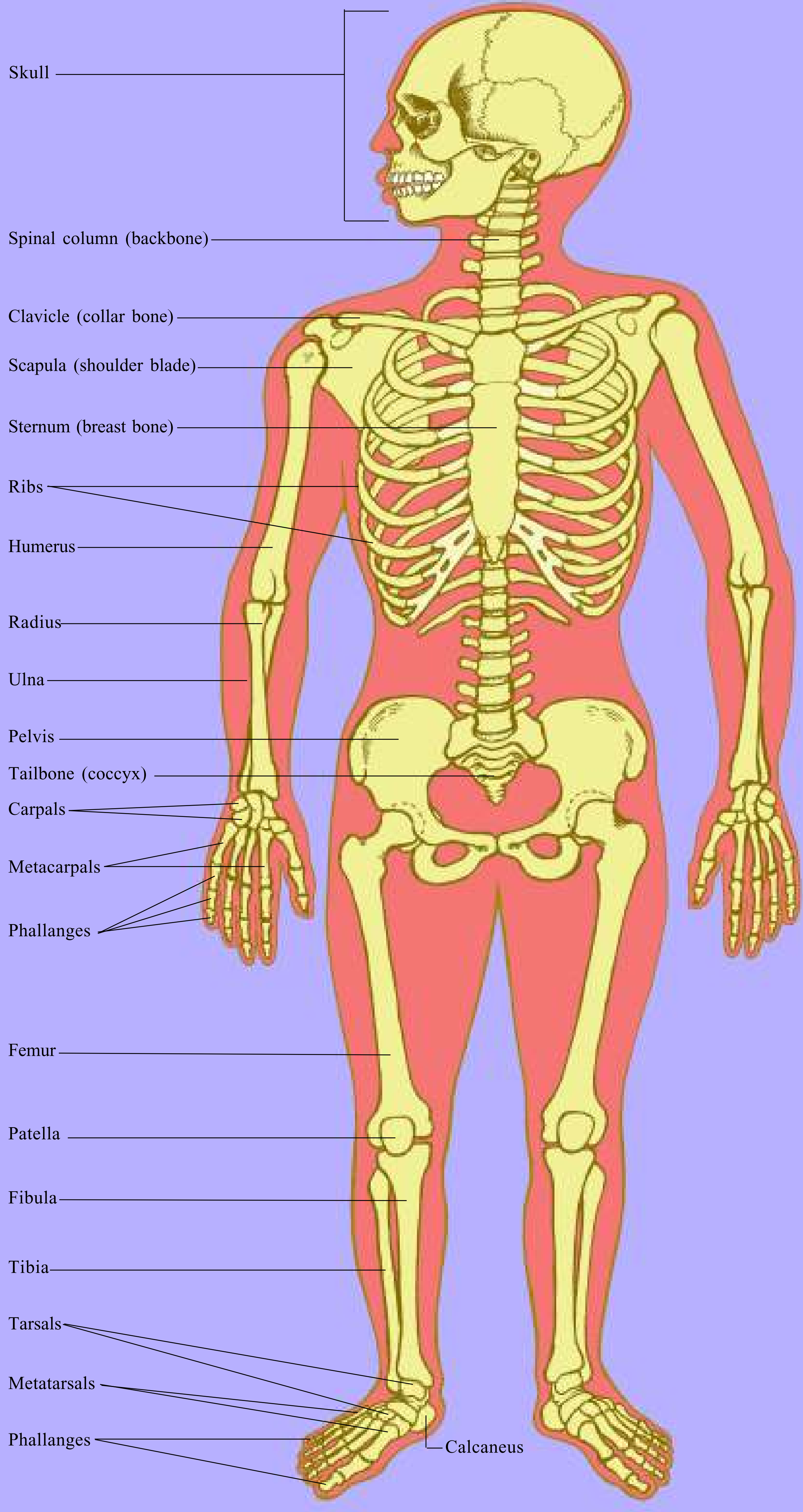
(side view)



One vertebra
(top view)





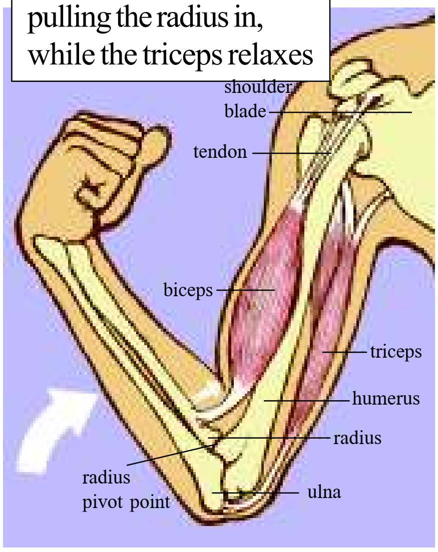

Skull
Spinal column (backbone)
Clavicle (collar bone)
Scapula (shoulder blade)
Sternum (breast bone)
Ribs
Humerus
Radius
Ulna
Pelvis
Tailbone (coccyx)
Carpals
Metacarpals
Phallanges
Femur
Patella
Fibula
Tibia
Tarsals
Metatarsals
Phallanges
Calcaneus

2 OUR MUSCULAR SYSTEM

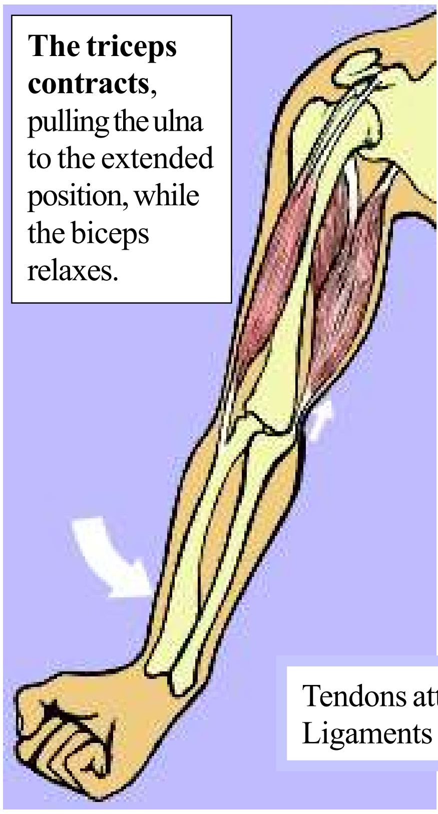
How do muscles make us move?

Tendons attach one end of the biceps and triceps to the shoulder blade and the other end to the radius or ulna. Each muscle can pull, but it cannot push. That is why two muscles are needed to bend the arm back and forth at the elbow.

The biceps contracts, pulling the radius in, while the triceps relaxes



The triceps contracts, pulling the ulna to the extended position, while the biceps relaxes.



There are three kinds of muscles:

1 Skeletal muscle

These muscles are attached to bones. They are also called 'voluntary muscles' because we can consciously contract them. (shown at right and on the facing page)



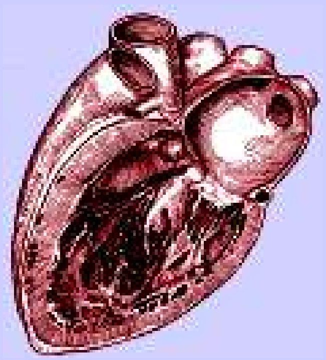


2 Smooth muscle

These are found in the walls of the digestive tract, urinary bladder, arteries, and other internal organs. They are 'involuntary muscles' because we do not consciously control them.

3 Cardiac muscle

These are the muscles of the heart. Their contraction is involuntary and continues in a coordinated rhythm as long as we live.

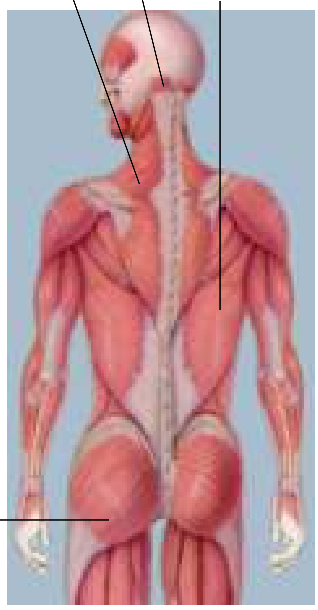


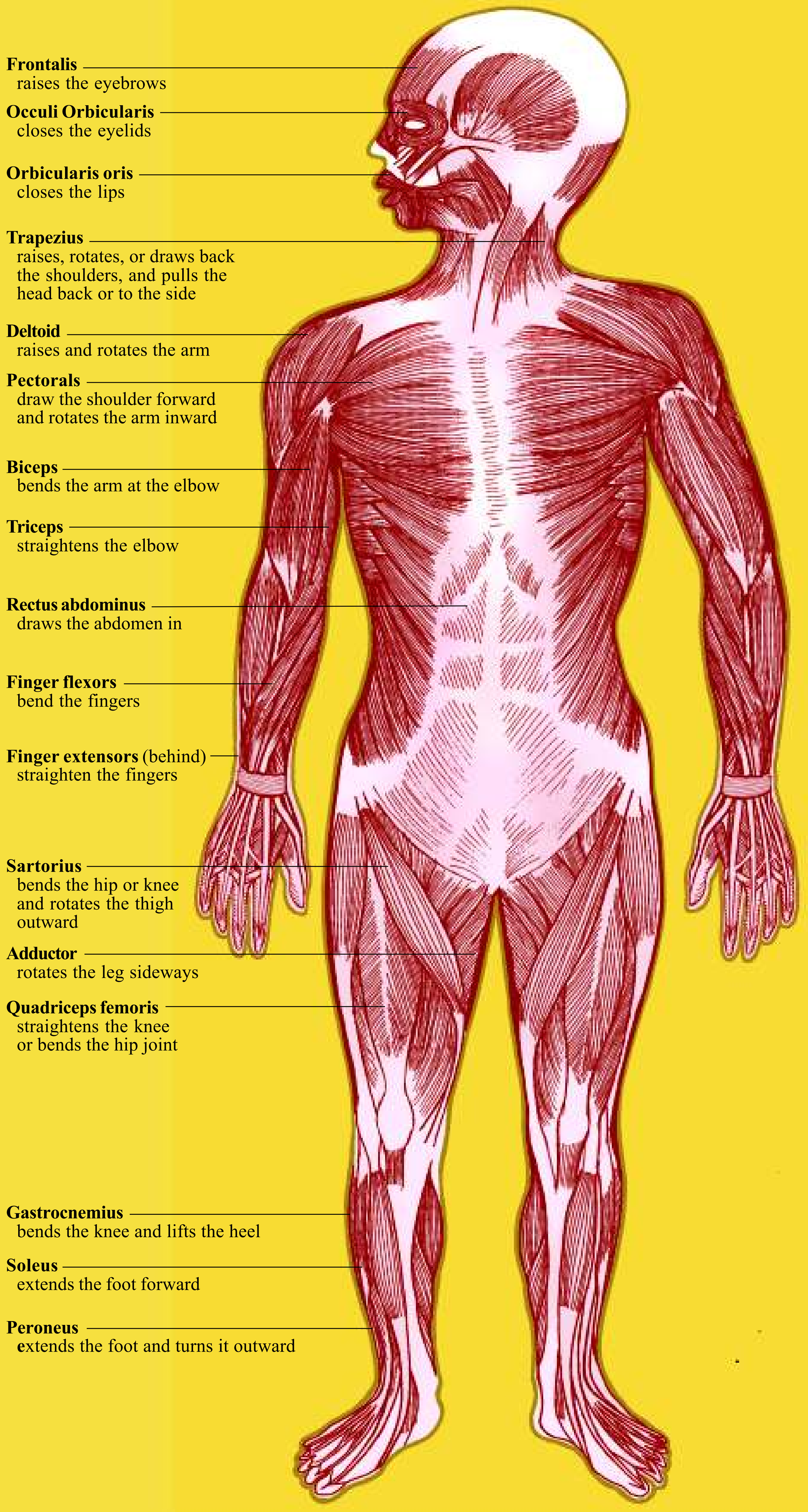


Ligaments attaching the wrist bones to each other.

Tendons attach muscles to bones.
Ligaments attach bones to bones.

Some muscles of the back





Frontalis
raises the eyebrows
Occuli Orbicularis
closes the eyelids
Orbicularis oris
closes the lips
Trapezius
raises, rotates, or draws back the shoulders, and pulls the head back or to the side
Deltoid
raises and rotates the arm
Pectorals
draw the shoulder forward and rotates the arm inward
Biceps
bends the arm at the elbow
Triceps
straightens the elbow
Rectus abdominus
draws the abdomen in
Finger flexors
bend the fingers
Finger extensors (behind)
straighten the fingers
Sartorius
bends the hip or knee and rotates the thigh outward
Adductor
rotates the leg sideways
Quadriceps femoris
straightens the knee or bends the hip joint
Gastrocnemius
bends the knee and lifts the heel
Soleus
extends the foot forward
Peroneus
extends the foot and turns it outward

3 OUR DIGESTIVE SYSTEM

Every cell in our body does work. Work requires energy, which is supplied by the food we eat. Food also supplies the small molecules **New Text** that are the building blocks for cell maintainance, growth, and function.

Digestion breaks down food into materials the body can use:

1. Your sense receptors work together with your brain to make you hungry. Saliva increases (you produce more than 1 litre/day), and helps digest food while it is mechanically torn, cut, crushed, and ground in your mouth.

2. The passages of your digestive system are lined with involuntary muscles that contract in waves to squeeze food along.

3. Your stomach stores food so that you need not eat continously. It also breaks down food with acid and enzymes.

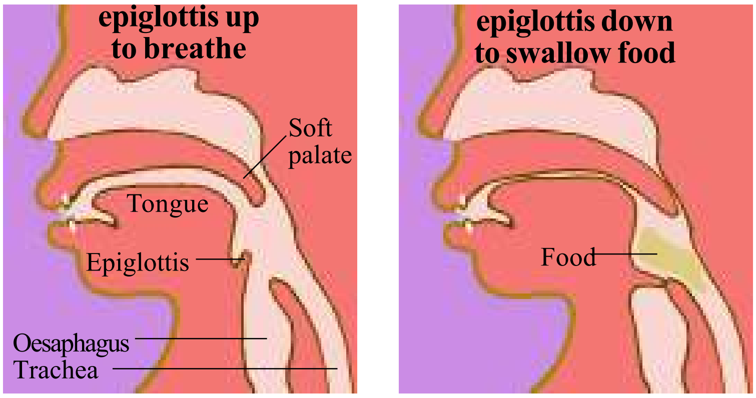
4. The salivary glands, pancreas, liver, and gallbladder secrete and store digestive juices.

5. The small intestine is where most of the chemical digestion and nutrient absorption into the bloodstream takes place.

6. The large intestine reclaims water and releases waste.

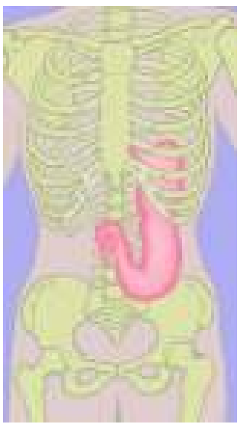
SWALLOWING

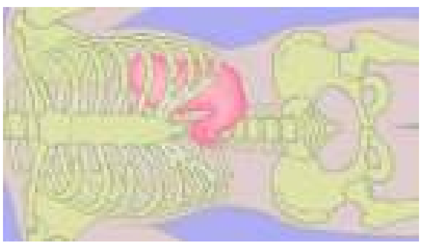
When swallowing, muscles move the epiglotis down to close the opening to the trachea, so that food and drink do not enter the lungs. The soft palate also moves up, so that food does not go up the nasal passage.



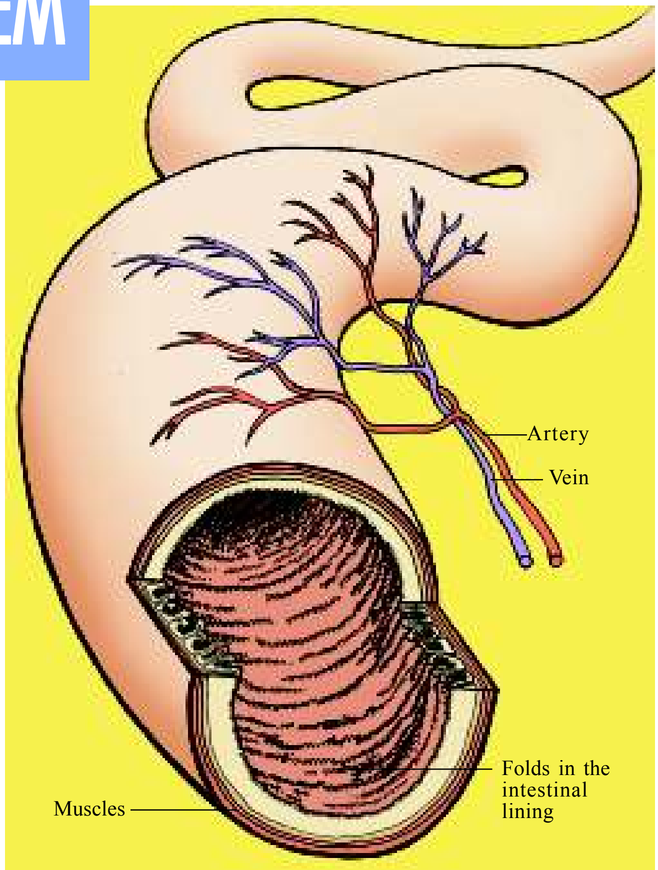
The stomach does not have one fixed shape

Everyone's internal organs are slightly different. The shape and position of your stomach also depends on how much food it contains, and whether you are standing or lying down.



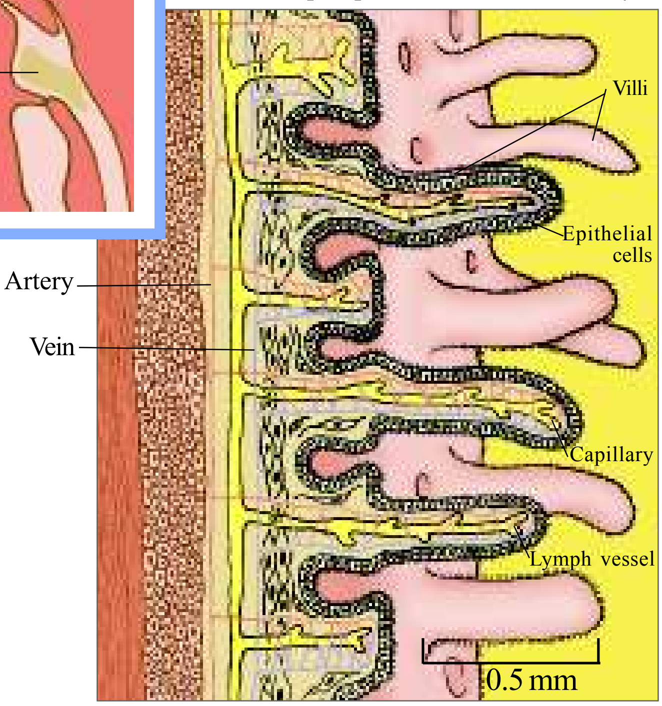


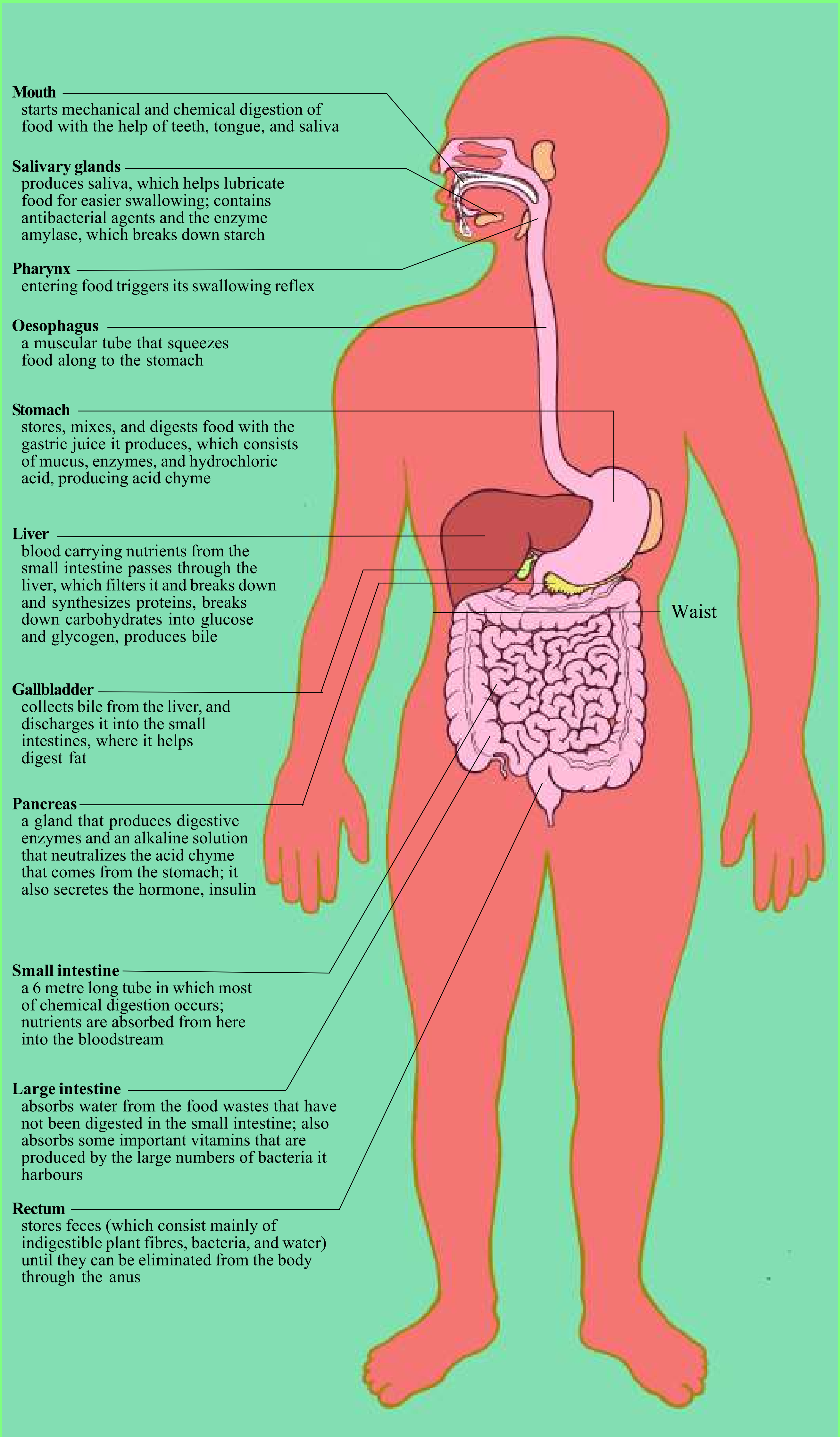
SMALL INTESTINE



The Intestinal Wall

In order to increase its surface area, the intestinal wall is folded, and each fold is lined with villi. This way, more cells come into contact with nutrients in the digested food. Nutrients enter the epethelial cells that line the villi, either by diffusion or active transport. They are then absorbed by capillaries and lymph vessels. Capillaries transport the nutrients to larger blood vessels, then to the portal vein,which goes to the liver. Then the nutrients go to the heart, to be pumped to the rest of the body.




Mouth
starts mechanical and chemical digestion of food with the help of teeth, tongue, and saliva
Salivary glands
produces saliva, which helps lubricate food for easier swallowing; contains antibacterial agents and the enzyme amylase, which breaks down starch
Pharynx
entering food triggers its swallowing reflex
Oesophagus
a muscular tube that squeezes food along to the stomach
Stomach
stores, mixes, and digests food with the gastric juice it produces, which consists of mucus, enzymes, and hydrochloric acid, producing acid chyme
Liver
blood carrying nutrients from the small intestine passes through the liver, which filters it and breaks down and synthesizes proteins, breaks down carbohydrates into glucose and glycogen, produces bile
Waist
Gallbladder
collects bile from the liver, and discharges it into the small intestines, where it helps digest fat
Pancreas
a gland that produces digestive enzymes and an alkaline solution that neutralizes the acid chyme that comes from the stomach; it also secretes the hormone, insulin
Small intestine
a 6 metre long tube in which most of chemical digestion occurs; nutrients are absorbed from here into the bloodstream
Large intestine
absorbs water from the food wastes that have not been digested in the small intestine; also absorbs some important vitamins that are produced by the large numbers of bacteria it harbours
Rectum
stores feces (which consist mainly of indigestible plant fibres, bacteria, and water) until they can be eliminated from the body through the anus

4 OUR RESPIRATORY SYSTEM

Through respiration we exchange gases with our environment. Our cells require a continuous supply of oxygen (O_2) in order to obtain energy from food molecules. Cells would also die if they were not able to get rid of the carbon dioxide (CO_2) they produce.

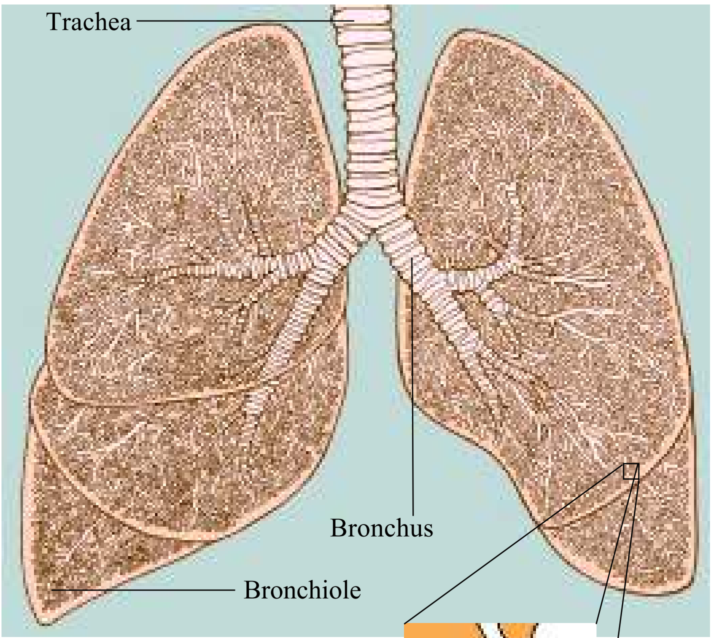
The 3 Processes of Gas Exchange:

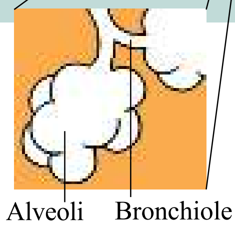
1. In our lungs, O_2 passes from the air into our blood, and CO_2 passes from our blood into the air. Some water vapour is also released into the air.

2. Our circulatory system transports O_2 and CO_2 to and from all the parts of our body. Haemoglobin molecules in our red blood cells transport O_2.

3. Cells take up O_2 and release CO_2

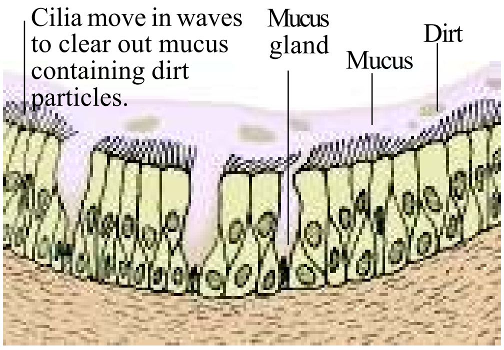
THE LUNGS





The lungs are sacs made of pleural membranes, containing a dense lattice of tubes: bronchi, and the smaller bronchioles. When we inhale air, it travels through this network and fills the tiny air sacs called alveoli. That is where gas exchange with the blood in capillaries takes place.

Mucus membranes line air passages



Hairs in our nostrils, as well as mucus and cilia throughout our air passages help remove dirt that enters the respiratory system in the air we breathe. Most of the mucus and dirt is swallowed and passes into the oesophagus and out through the digestive system.

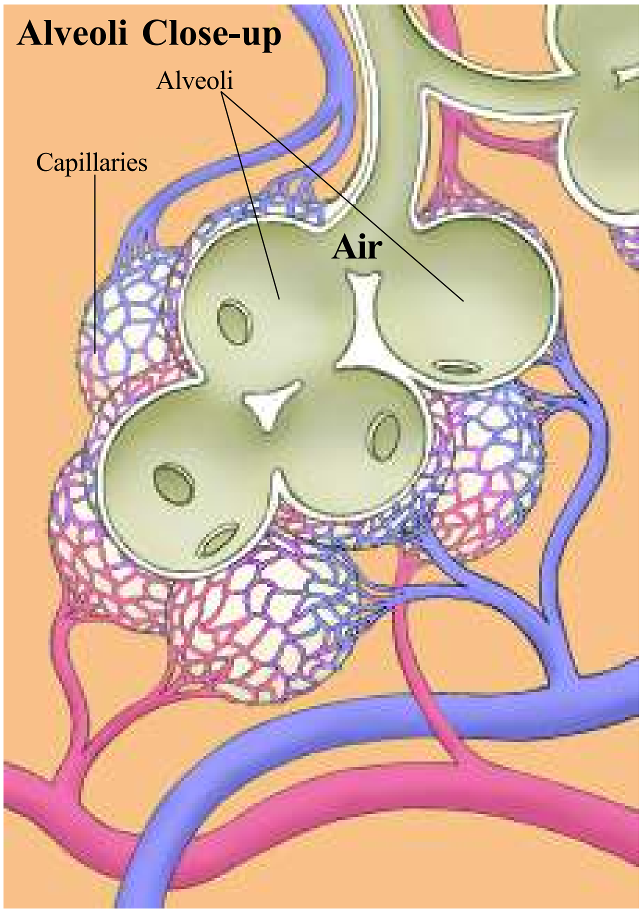
When we inhale, where does the air go?

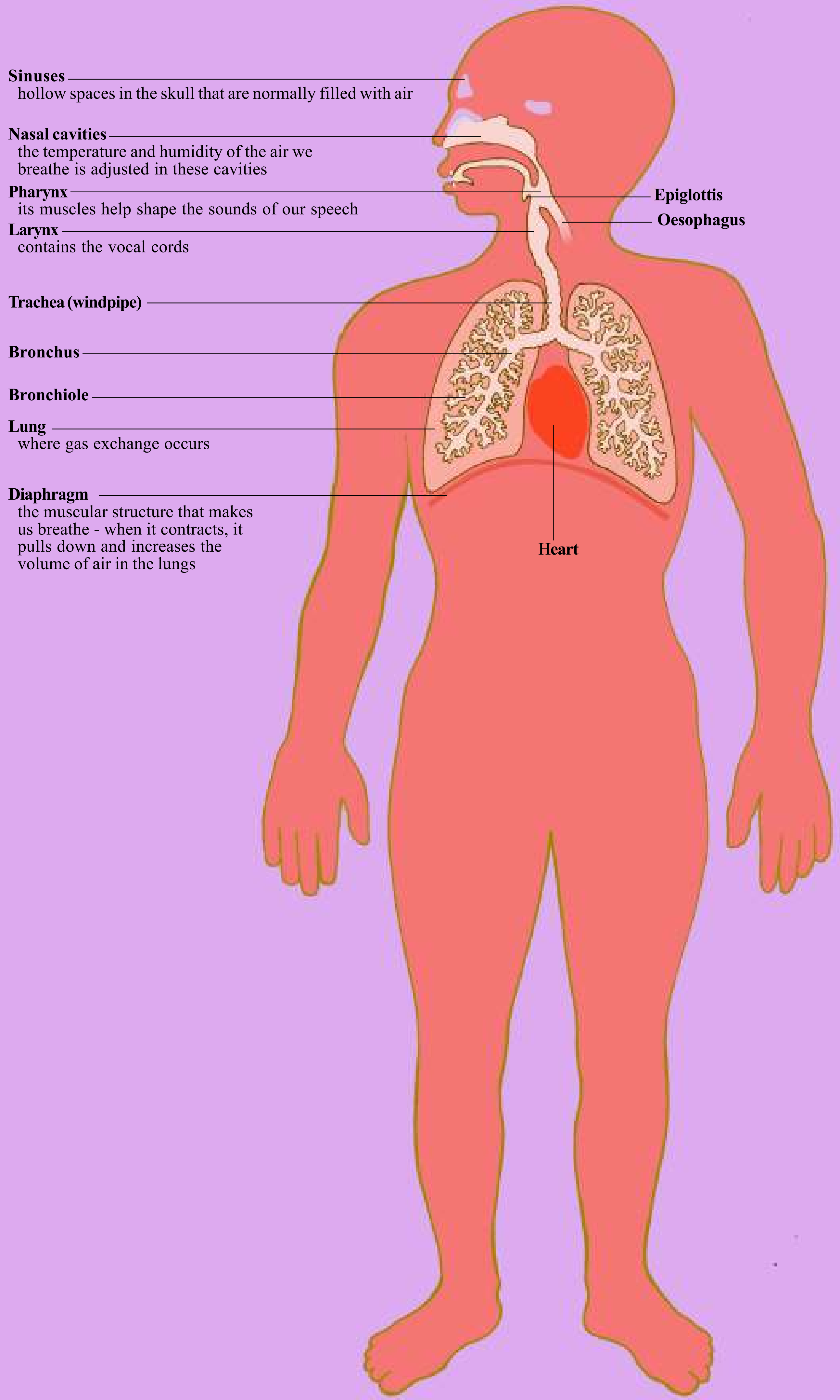
Nostrils
↓
Nasal cavity
↓
Pharynx
↓
Larynx
↓
Trachia
↓
Bronchus
↓
Bronchiole
↓
Alveolus

What happens in the aveoli?

O_2 from the air diffuses through the thin layer of cells that forms the aveoli walls. Then it enters the web of capillaries that surround each aveoli. CO_2 goes in the opposite direction, from the capillaries to the air.

In the capillaries, O_2 diffuses into red blood cells. Red blood cells contain protein molecules called haemoglobin, which contain iron atoms. Each iron atom can carry an O_2 molecule. When haemoglobin binds O_2 it turns red. Blood without oxygen looks bluish - after passing through the lungs it turns red.

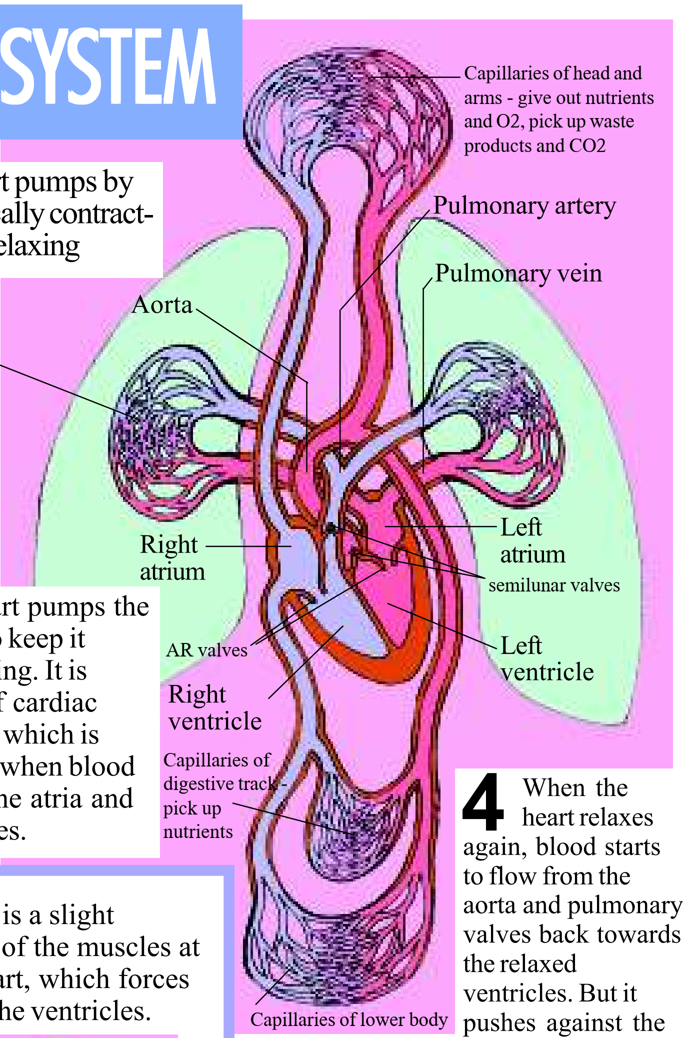



Sinuses
hollow spaces in the skull that are normally filled with air
Nasal cavities
the temperature and humidity of the air we breathe is adjusted in these cavities
Pharynx
its muscles help shape the sounds of our speech
Larynx
contains the vocal cords
Trachea (windpipe)
Bronchus
Bronchiole
Lung
where gas exchange occurs
Diaphragm
the muscular structure that makes us breathe - when it contracts, it pulls down and increases the volume of air in the lungs
Epiglottis
Oesophagus
Heart

5 OUR CIRCULATORY SYSTEM

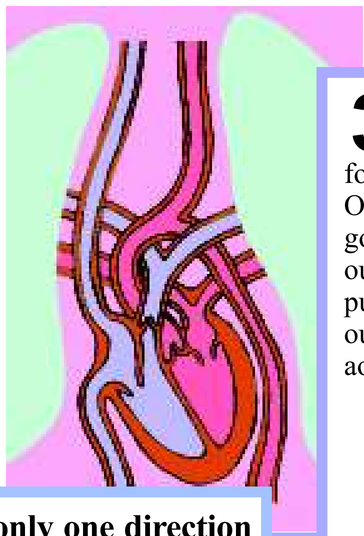
The circulatory system transports respiratory gases, nutrient molecules, wastes, and hormones throughout the body. These materials are carried by an intricate network of blood vessels, which follow continuous circuits from the heart through arteries, capillaries, and veins back to the heart.
The circulatory system also regulates our body temperature.

The heart pumps by rhythmically contracting and relaxing

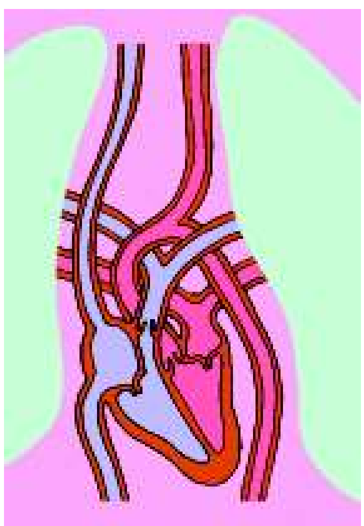


1 The heart pumps the blood to keep it circulating. It is made of cardiac muscle, which is relaxed when blood enters the atria and ventricles.

2 Then there is a slight contraction of the muscles at the top of the heart, which forces more blood into the ventricles.

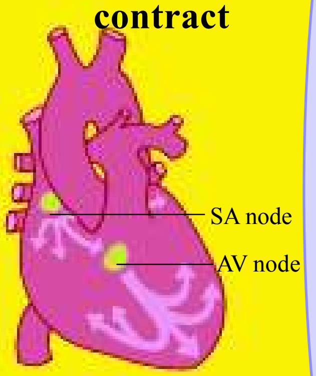


3 The main heart muscles (at the bottom of the heart) contract to force blood out of the ventricles. One-way valves prevent blood from going back into the atria. Blood flows out of the right ventricle through the pulmonary arteries into the lungs, and out the left ventricle through the aorta to the rest of the body.



4 When the heart relaxes again, blood starts to flow from the aorta and pulmonary valves back towards the relaxed ventricles. But it pushes against the semilunar valves, which snap shut.

Electrical signals make the heart rhythmically contract

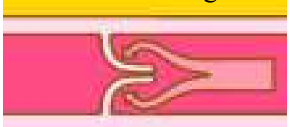


An electrical signal is generated by the SA node, and it makes the muscles of the atria contract. The signal spreads, but is slightly delayed in the AV node, which allows the atria time to empty. Then it reaches the bottom of the heart and travels up the sides of the ventricles, causing them to strongly contract.

Valves allow blood to flow in only one direction



Blood flows from left to right

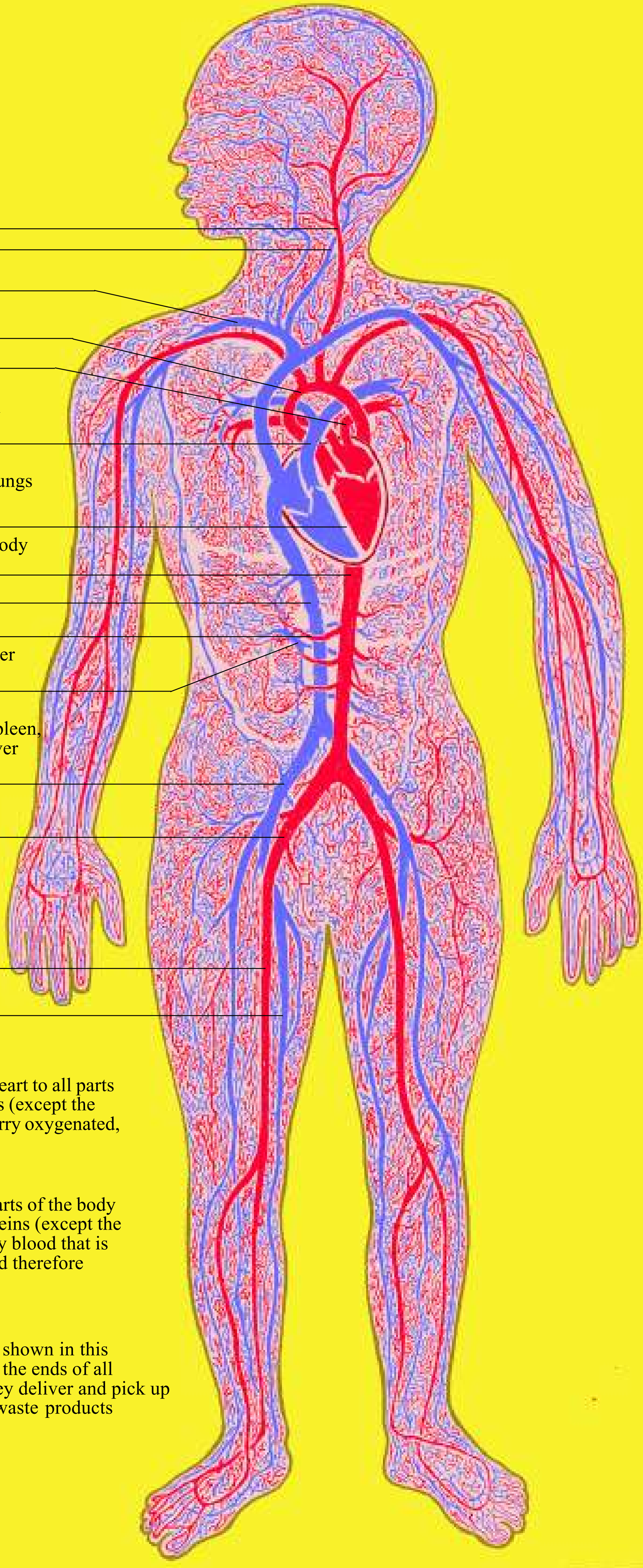


Blood cannot flow from right to left

Valves automatically close when blood pushes in the wrong direction.

Your heartbeat sounds like lub-dup, lub-dup, lub-dup... The sound lub comes from blood in the ventricles pushing against (and closing) the AV valves to the atria. The dup comes from the semilunar valves snapping shut after blood is forced out of the ventricles.

Valves similar to these are found in some veins, and in the lymphatic system, as well as in the heart.



Arteries
carry blood from the heart to all parts of the body; all arteries (except the pulmonary arteries) carry oxygenated, red blood

Veins
carry blood from all parts of the body back to the heart; all veins (except the pulmonary veins) carry blood that is depleted of oxygen and therefore bluish in colour

Capilliaries
very narrow tubes not shown in this diagram, they connect the ends of all arteries to to veins; they deliver and pick up gases, nutrients, and waste products

6 OUR LYMPHATIC SYSTEM

To remain healthy, our bodies must be regulated in a state of internal balance, under ever-changing conditions.

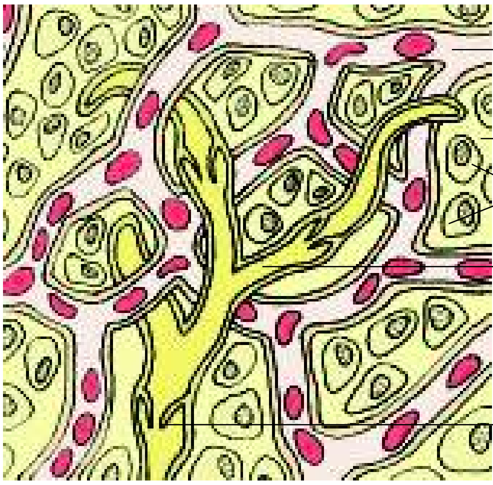
All the cells in our body live in an interstitial fluid, which supplies their nourishment and carries away waste products. This fluid leaks out from the circulatory system. The lymphatic system provides a way to return excess fluid to the circulatory system, thus keeping fluids in balance.

The fluid which is carried by the lymph vessels is called lymph. It is similar to interstitial fluid, but it has less O_2 and protein, and more fat.

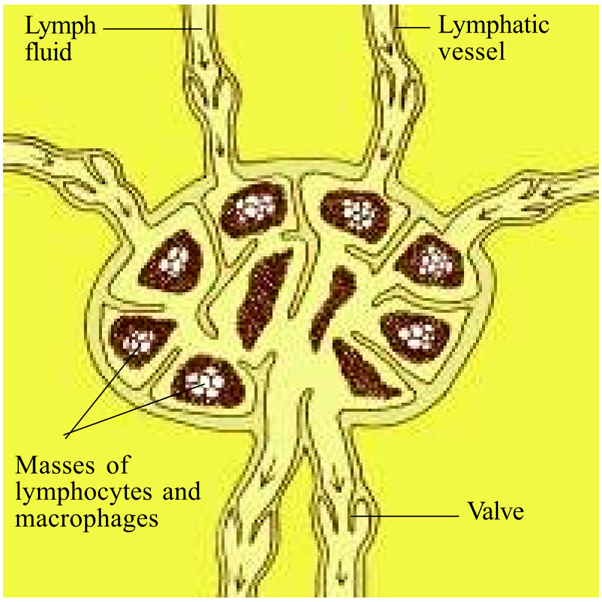
The lymphatic system also plays a role in defending the body from infection. The fluid that is picked up is taken through larger and larger lymph vessels to lymph nodes. Lymph nodes contain lymphocytes and macrophages, which attack microbes and even cancer cells that may be in the lymph.

Finally, lymph re-enters the circulatory system through the thoracic duct and the right lymphatic duct, which drain into veins in the shoulders.

Lymph vessels and capillaries



A LYMPH NODE

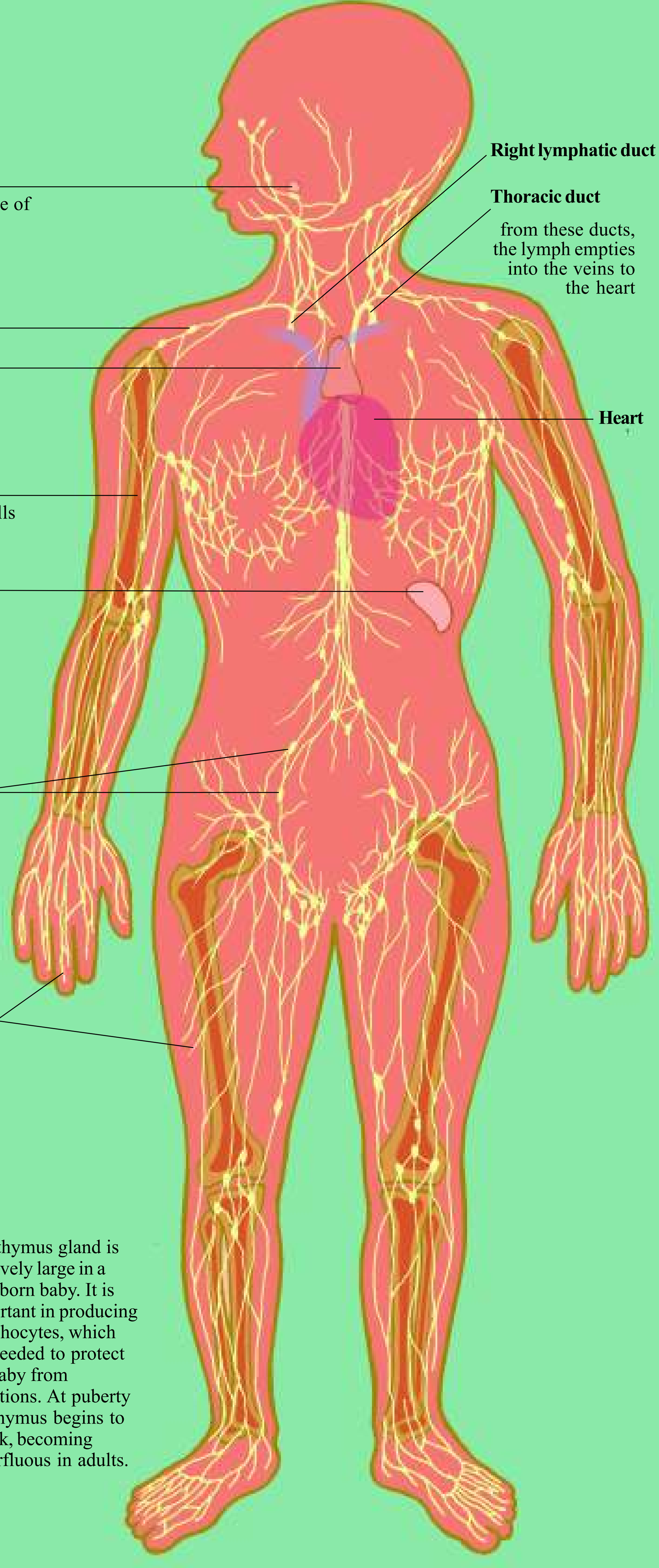


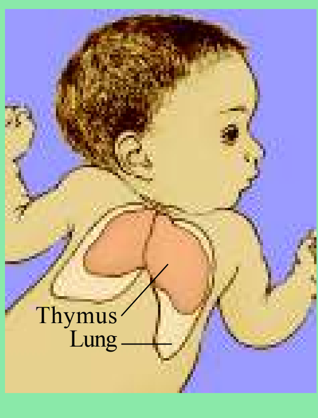


White blood cells in the lymphatic system fight disease

The immune response: lymphocytes are white blood cells that defend the body from viruses, bacteria, and even cancer cells. These invaders are neutralised when their antigens (proteins on their surfaces) are recognized by antibodies made by **T-cells** and **B-cells** (types of **lymphocytes**) .

The inflammatory response: damaged cells release chemicals that signal blood vessels to dilate and release fluid and white blood cells such as **macrophages**, which attack any foreign body.

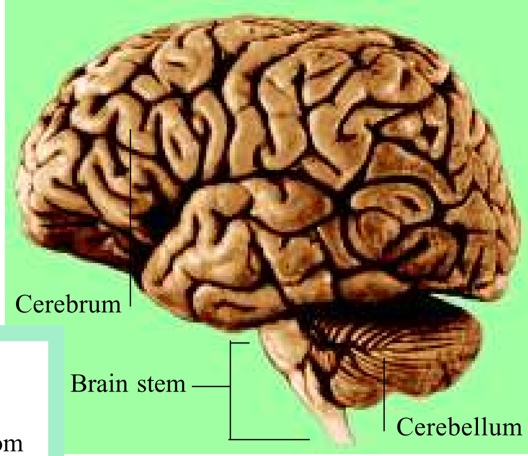




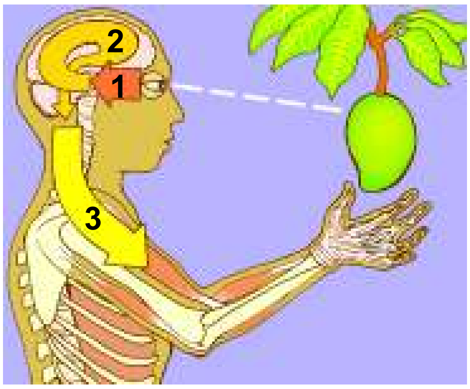
The thymus gland is relatively large in a new-born baby. It is important in producing lymphocytes, which are needed to protect the baby from infections. At puberty the thymus begins to shrink, becoming superfluous in adults.

7 OUR NERVOUS SYSTEM

The nervous system consists of the structures and processes that make up the brain, the spinal cord, and the peripheral nerves distributed throughout the body.



The Functions of the Nervous System:



1. **Sensory Input**
   the conduction of signals from sensory receptors
2. **Integration**
   the interpretation of the sensory signals and the formulation of responses
3. **Motor output**
   the conduction of signals from the brain and spinal cord to effectors, such as muscle and gland cells.

The Brain

The brain is the site of consciousness. It produces thoughts, feelings, memory, and creativity. It monitors and controls our unconscious and well as conscious actions.

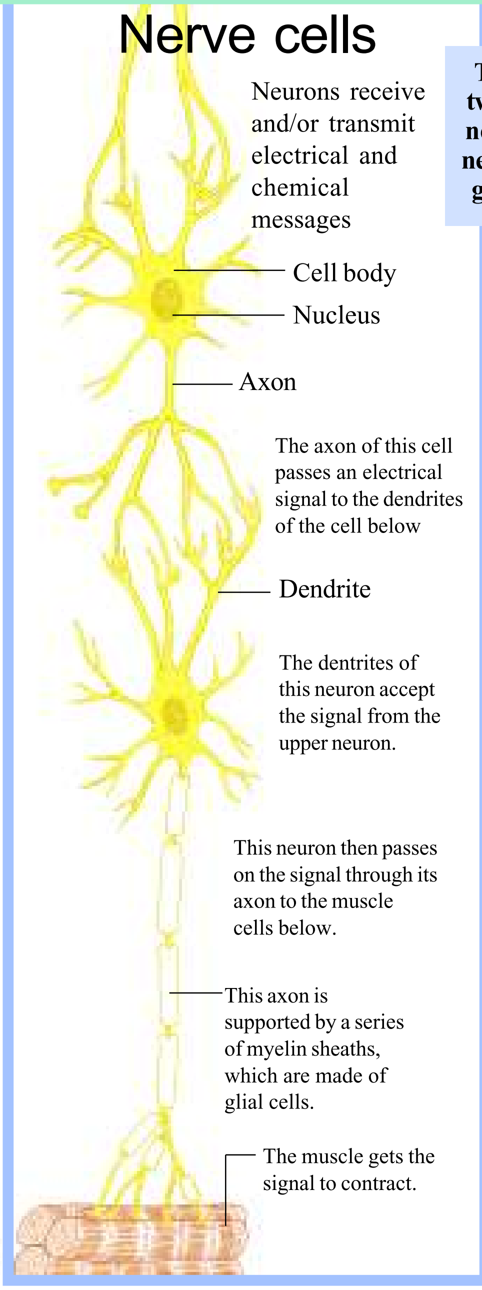
The brain is an exceedingly complex organ, made up of billions of interconnected and interacting nerve cells. An intricate network of blood vessels bring a constant supply of oxygen and glucose, from which these nerve cells get the energy they need to function.

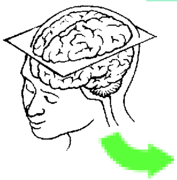
Nerve cells

Neurons receive and/or transmit electrical and chemical messages

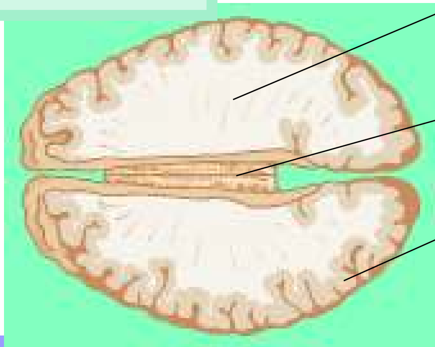
There are two types of nerve cells: neurons and glial cells.

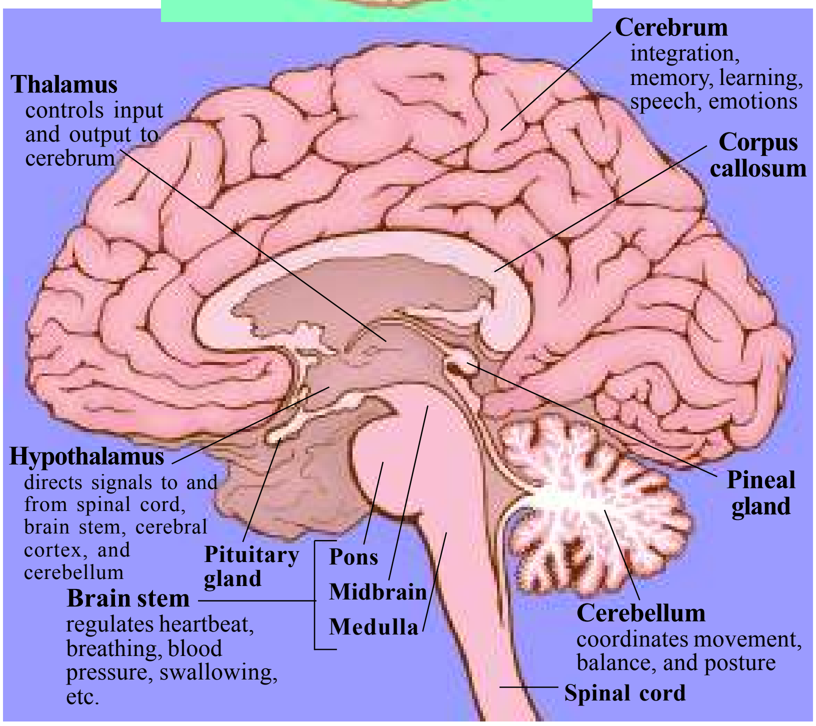
The major nerves are bundles of axons.
One axon may be more than 1 metre long.

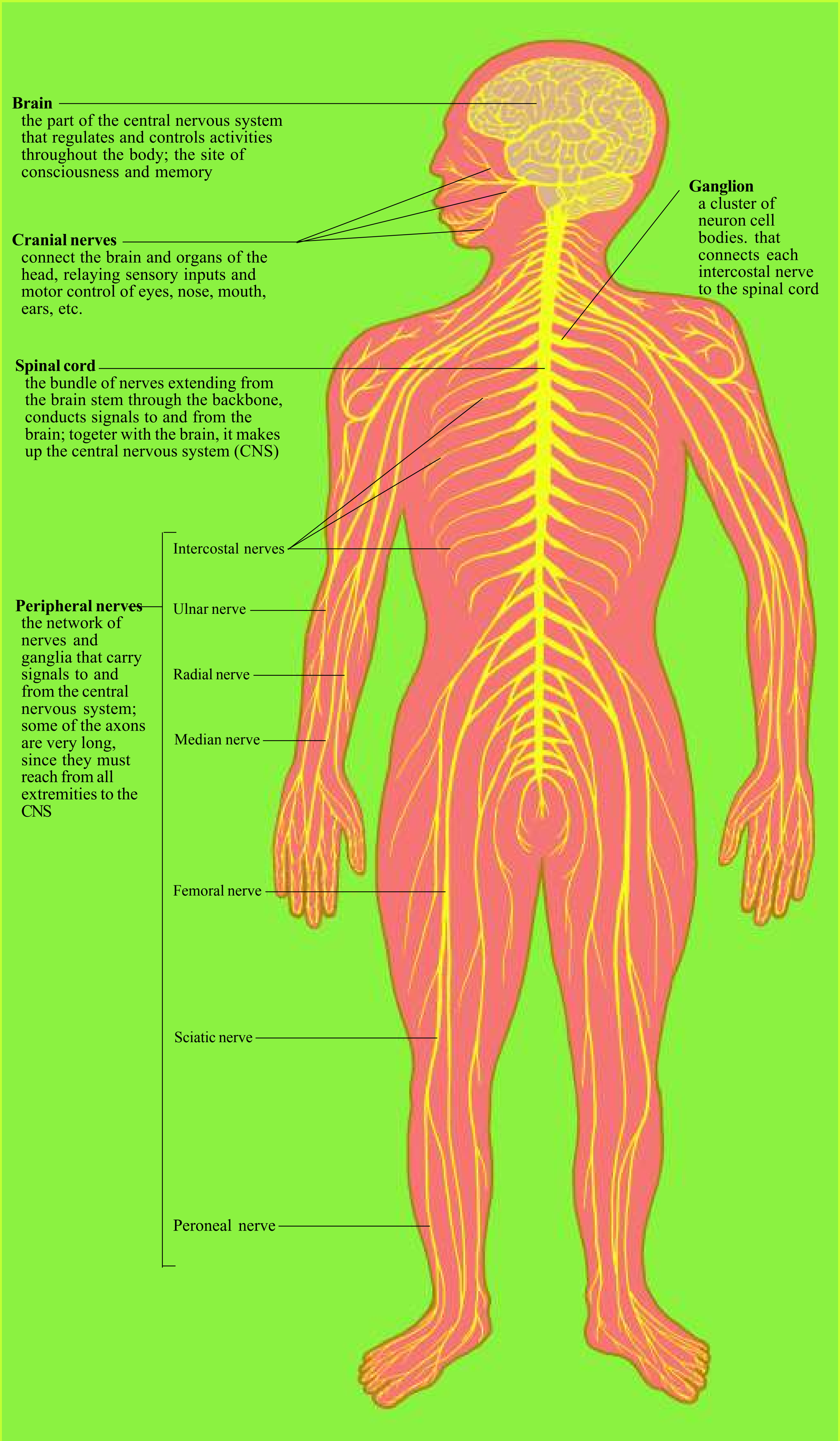




This section through the brain is shown here






Brain
the part of the central nervous system that regulates and controls activities throughout the body; the site of consciousness and memory
Cranial nerves
connect the brain and organs of the head, relaying sensory inputs and motor control of eyes, nose, mouth, ears, etc.
Ganglion
a cluster of neuron cell bodies. that connects each intercostal nerve to the spinal cord
Spinal cord
the bundle of nerves extending from the brain stem through the backbone, conducts signals to and from the brain; togeter with the brain, it makes up the central nervous system (CNS)
Peripheral nerves
the network of nerves and ganglia that carry signals to and from the central nervous system; some of the axons are very long, since they must reach from all extremities to the CNS
Intercostal nerves
Ulnar nerve
Radial nerve
Median nerve
Femoral nerve
Sciatic nerve
Peroneal nerve

8 OUR ENDOCRINE SYSTEM

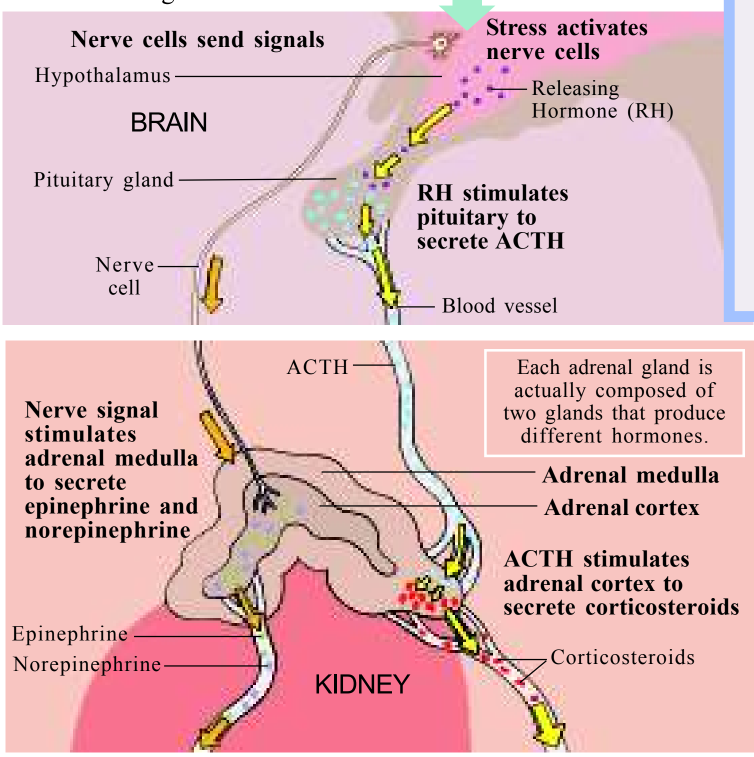
Many of our body's functions are controlled by the endocrine system, which consists of glands that make and secrete regulatory chemicals called hormones.

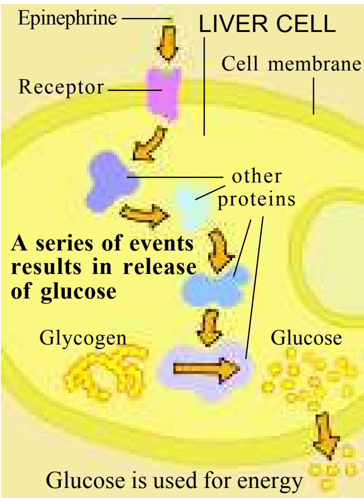
Molecular messengers: Hormones are molecules that are secreted in one part of the body and travel through the bloodstream to control what happens in another part. Endocrine glands secrete hormones directly into the bloodstream.

How do hormones help us respond to stress?

Upon sensing stress, the brain responds, sending signals to the adrenal glands

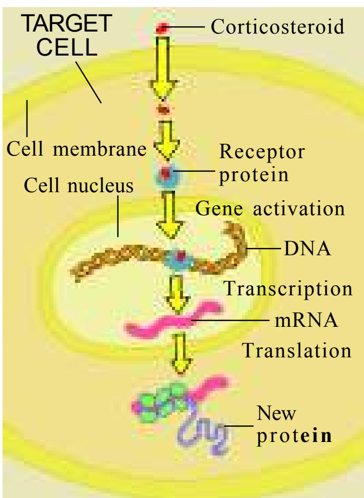






Immediate response:

Increased blood glucose, blood pressure, breathing rate, and metabolic rate



Long-term response:

Kidneys retain sodium and water, increased glucose, increased blood volume and blood pressure, immune system may be suppressed

There are two main kinds of hormones:

(1) Hormones made from amino acids

These hormones may be modified amino acids, peptides, or proteins. They work by binding to and activating specific receptors on cell membranes. This causes a series of events inside the cell.

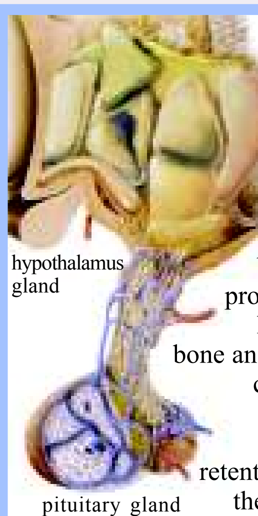
Examples: epinephrine, norepinephrine, insulin, melatonin, LH, FSH

(2) Steroid Hormones

Steroids are lipids made from chloresterol. Steroid hormones enter target cells and attach to the cell's DNA to either start or stop production of a protein (the gene product).

Examples: corticosteroids, oestrogen, testosterone, androgen

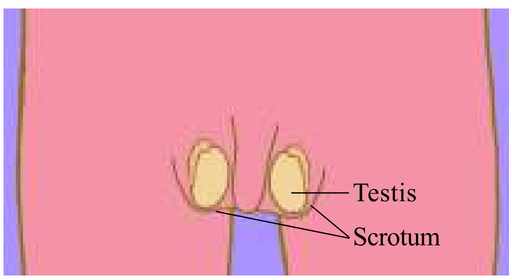
The Pituitary Gland

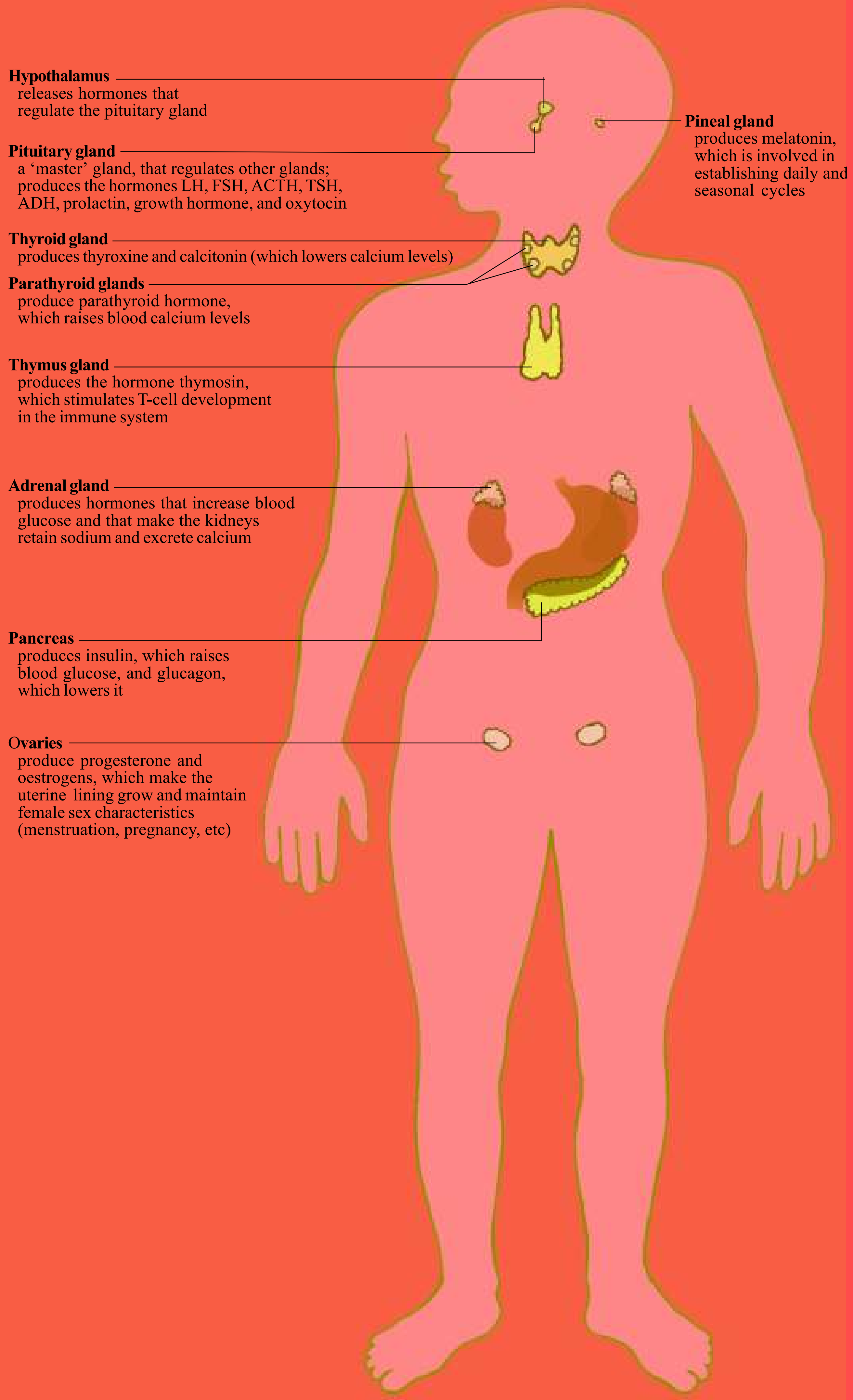


The pituitary gland, located in the brain, produces hormones that regulate hormones produced by other glands. It also produces several different hormones that regulate bone and muscle growth, body changes at puberty, the menstrual cycle, child birth, lactation, water retention in the kidneys, and the male sexual response.

Males have testes instead of ovaries

A testis gland hangs inside each scrotum. After puberty, in addition to producing sperm, the testes produce testosterone, the hormone that stimulates growth of facial and genital hair, a deeper voice, and muscle and bone growth.




Hypothalamus
releases hormones that regulate the pituitary gland
Pituitary gland
a ‘master’ gland, that regulates other glands; produces the hormones LH, FSH, ACTH, TSH, ADH, prolactin, growth hormone, and oxytocin
Thyroid gland
produces thyroxine and calcitonin (which lowers calcium levels)
Parathyroid glands
produce parathyroid hormone, which raises blood calcium levels
Thymus gland
produces the hormone thymosin, which stimulates T-cell development in the immune system
Adrenal gland
produces hormones that increase blood glucose and that make the kidneys retain sodium and excrete calcium
Pancreas
produces insulin, which raises blood glucose, and glucagon, which lowers it
Ovaries
produce progesterone and oestrogens, which make the uterine lining grow and maintain female sex characteristics (menstruation, pregnancy, etc)
Pineal gland
produces melatonin, which is involved in establishing daily and seasonal cycles

9 OUR URINARY SYSTEM

The urinary system regulates fluids in the body. The kidneys help maintain the amount, chemical composition, and acidity of fluids. They do this by collecting water and wasteproducts from the blood and excreting them in the form of urine. Urine is stored in the urinary bladder before it is excreted through the urethra.



Why do we drink water?

Our body is about 70% water. Some parts are more or less watery: the grey matter of the brain is about 85% water; fat cells contain only about 15% water.

A person normally takes in between 1.5 and 3.5 litres of water each day (in both food and drink), depending on how hot and dry the weather is. Obviously we cannot keep accumulating all that water - our body gets rid of the same amount of water as it ingests.

So why do we need to keep taking in water each day?

(1) To sweat. When we sweat, water evaporates from our skin, which removes excess heat from our body. So the hotter we get, the more water we need to drink. About 40% of the water we take in leaves as sweat.

(2) To wash the insides of our bodies - to remove waste products. This is what the urinary system does. About 60% of the water we take in leaves as urine.

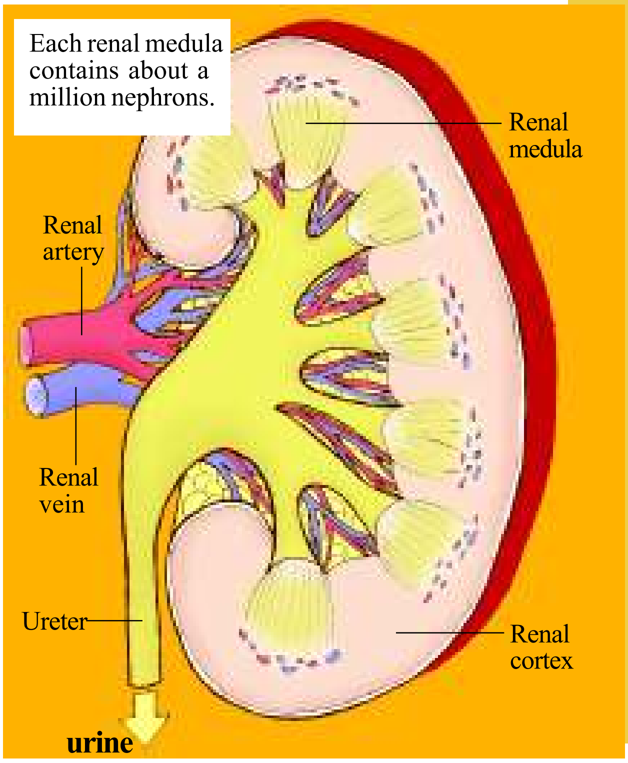
How do the kidneys remove wastes from the blood?

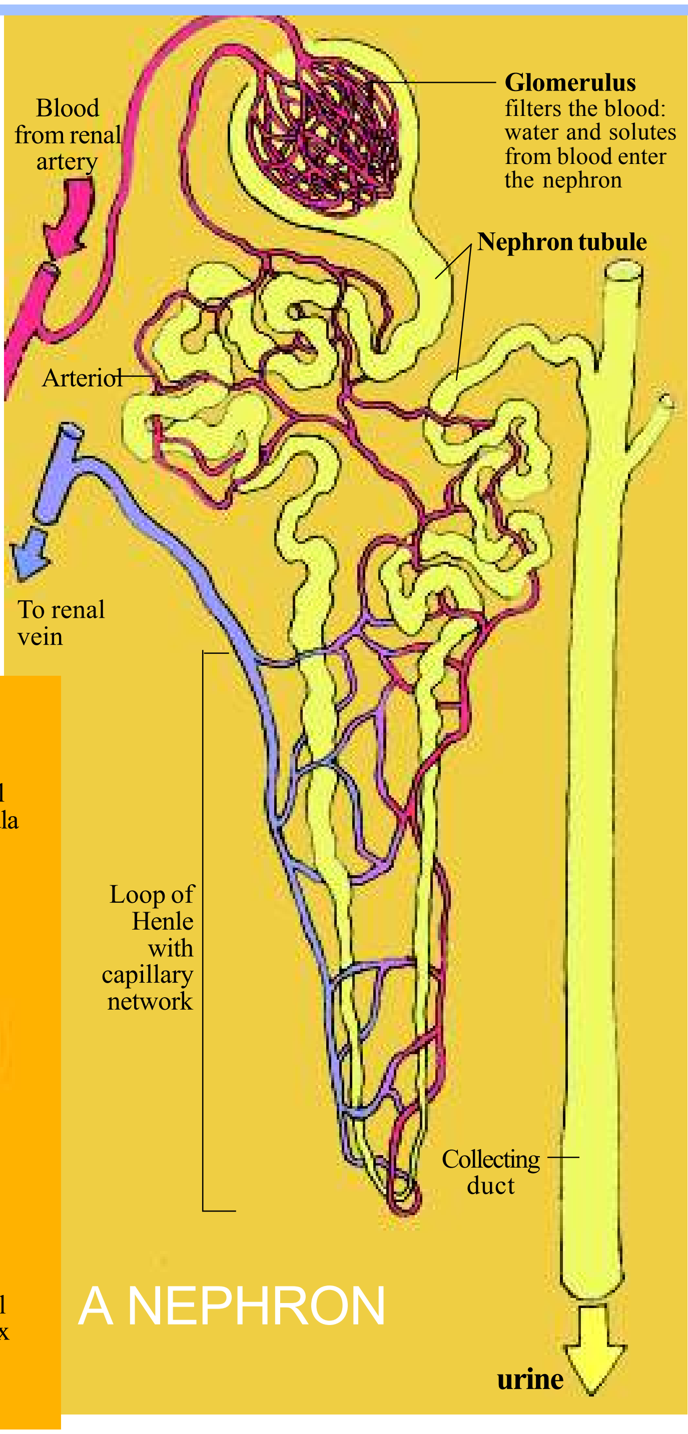
Each kidney contains millions of nephrons, which filter the blood that passes through them. In the nephron, capillaries pass through the glomerulus. Slits in the glomerulus prevent blood cells and larger molecules from passing out.

The acidity and concentrations of various substances in the blood are maintained by diffusion and active transport of excess amounts into urine collecting tubules.

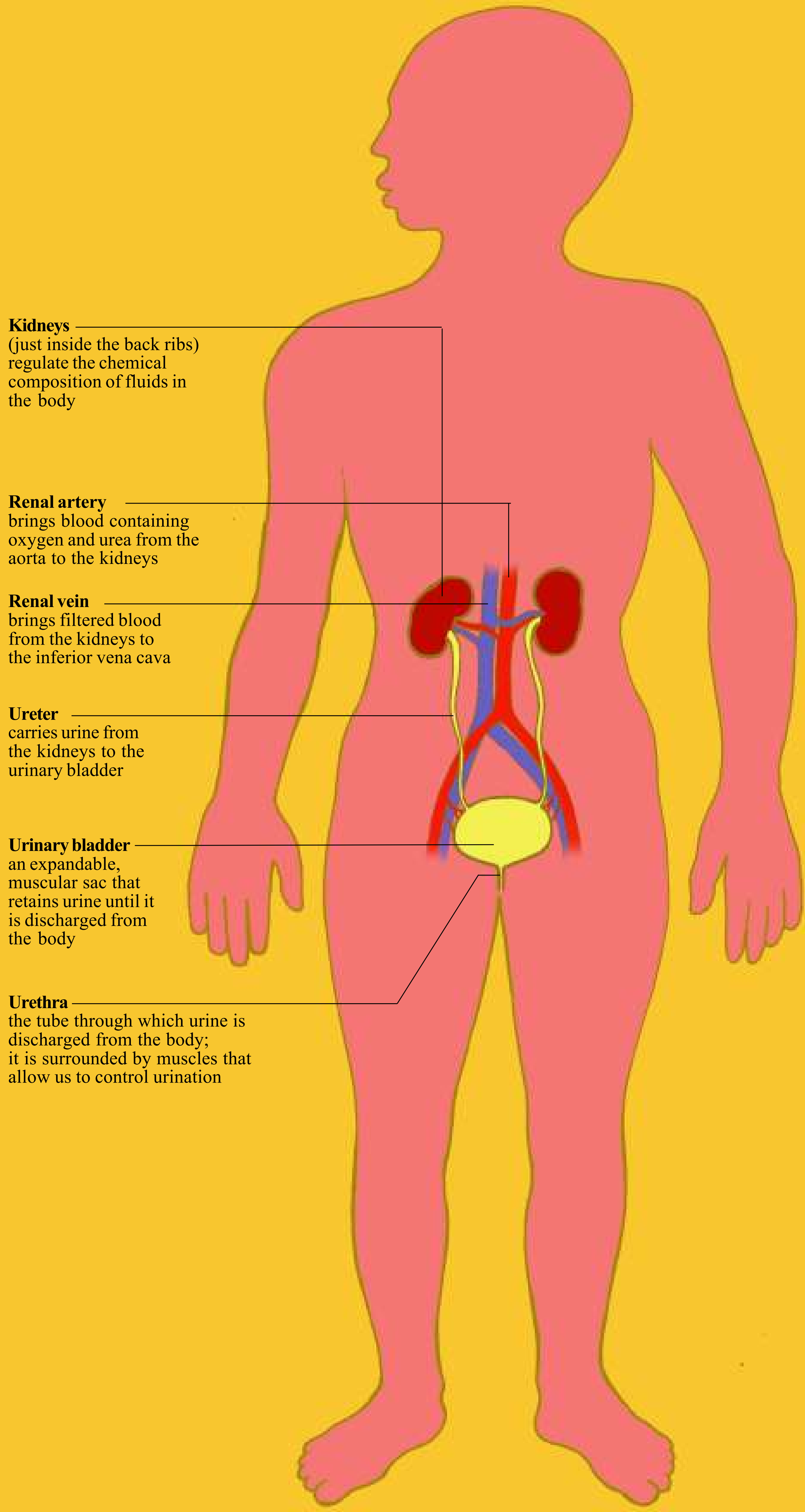
The urine is composed of water (about 95%), potassium, bicarbonate, sodium, glucose, amino acids, and the waste products urea and uric acid.

THE KIDNEY





A NEPHRON


Kidneys
(just inside the back ribs) regulate the chemical composition of fluids in the body
Renal artery
brings blood containing oxygen and urea from the aorta to the kidneys
Renal vein
brings filtered blood from the kidneys to the inferior vena cava
Ureter
carries urine from the kidneys to the urinary bladder
Urinary bladder
an expandable, muscular sac that retains urine until it is discharged from the body
Urethra
the tube through which urine is discharged from the body; it is surrounded by muscles that allow us to control urination

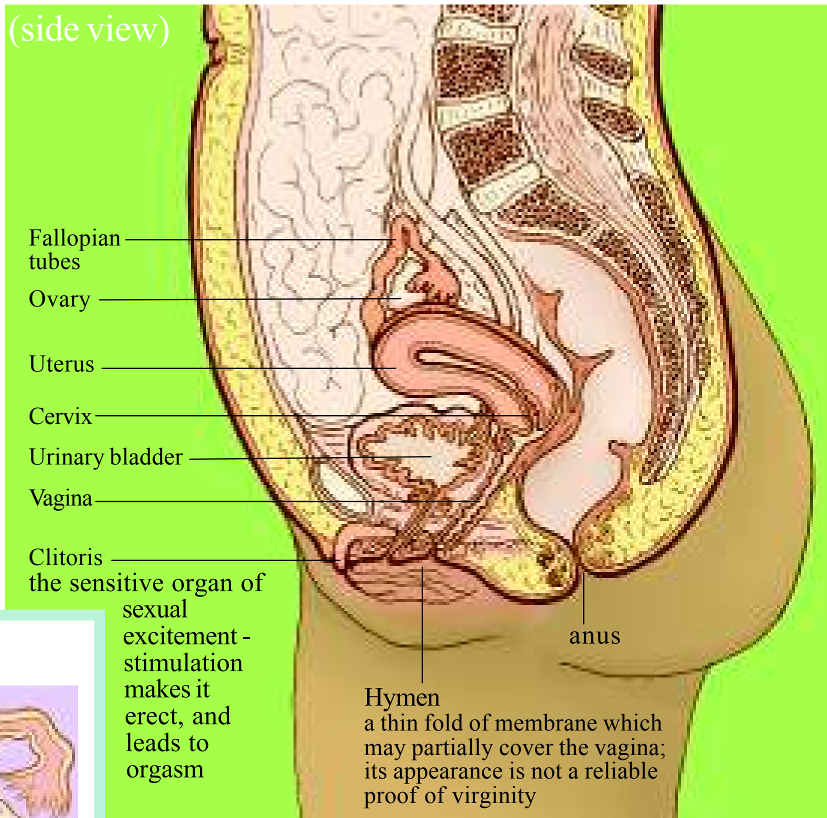
10 OUR REPRODUCTIVE SYSTEM



In this drawing, the uterus has been cut open to show the developing fetus it protects and nourishes

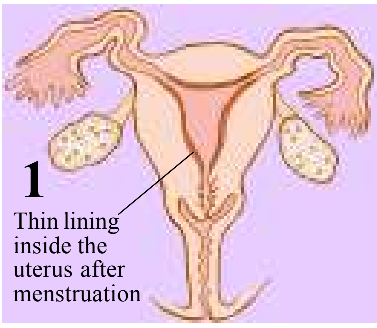
The survival of the human population is maintained by reproduction. In order for sexual reproduction to occur, a woman's ovaries produce ova (eggs) and a man's testes produce sperm. After an egg has been fertilised by a sperm, it grows inside the woman's uterus to produce a new human being.

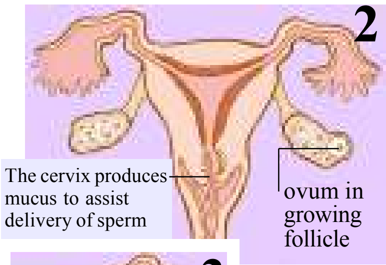
Female Reproductive Organs



The Menstrual Cycle

Between the ages of about 12 and 50, a woman produces one ripe ovum about every 24-30 days. The ova are all present in the ovaries at birth, but they are not ready to be released.





Now one ova is almost ready. The lining of the uterus has also thickened in order to get ready to nourish a fertilized ovum.

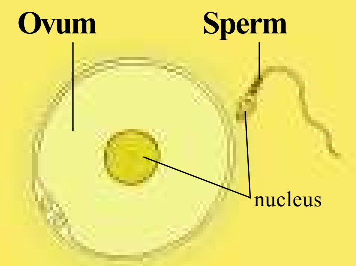


Ovulation: the ova is released, to go into the fallopian tube, where it may be fertilized by a sperm.

In case fertilisation does not occur, the lining is shed (menstrual bleeding).



...then a new cycle begins.

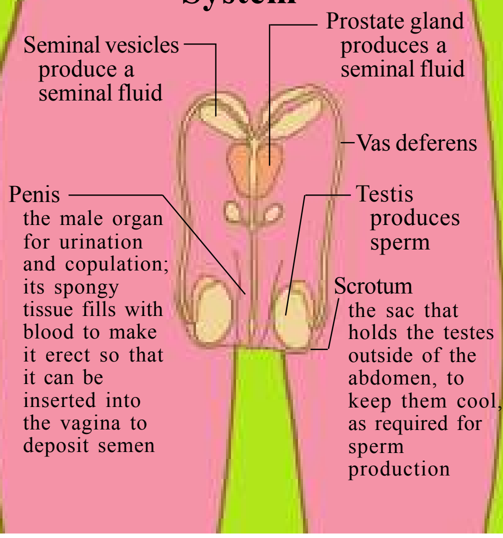


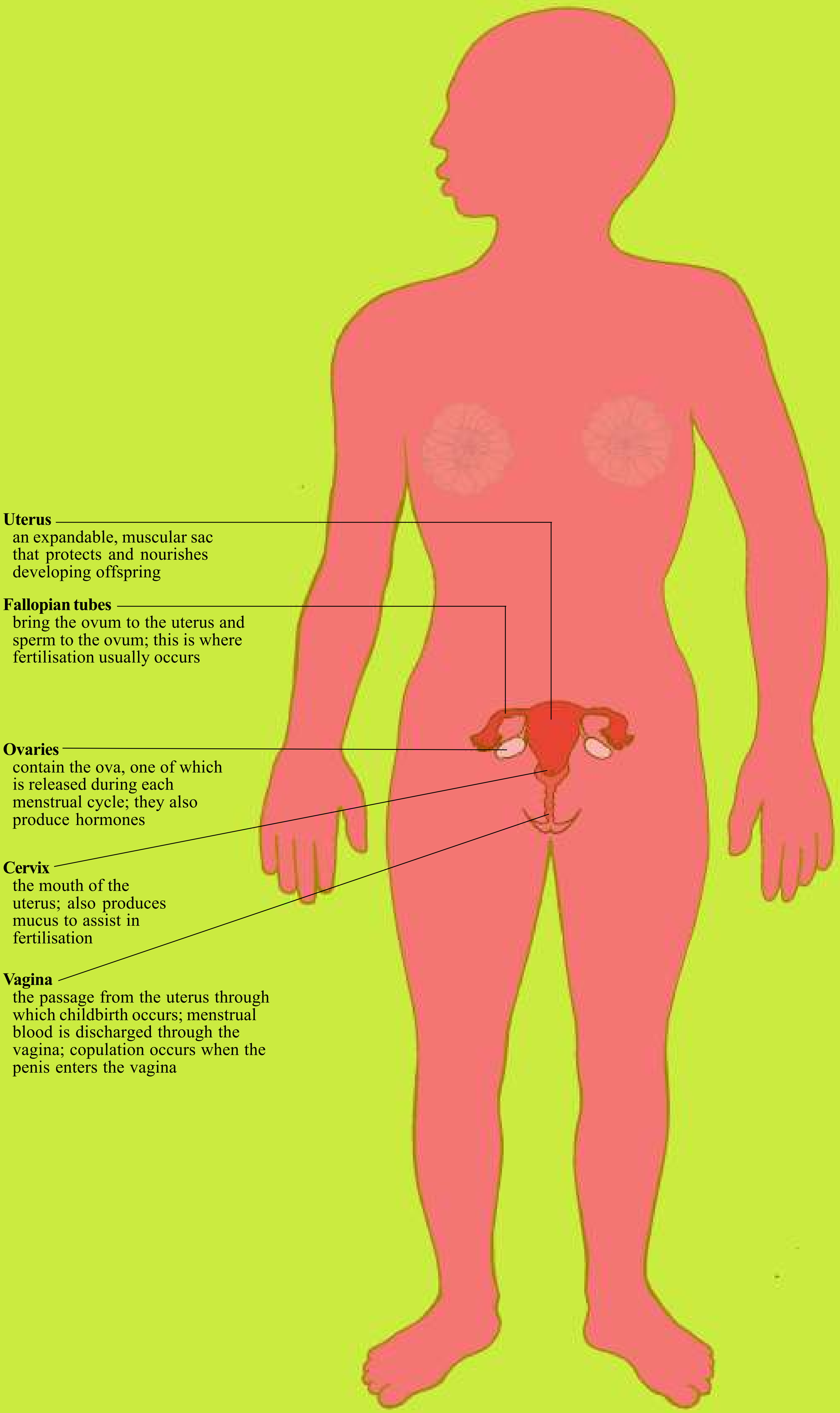
Each consists of a single cell, although the egg is much larger than the sperm.

At **conception**, a female egg, or ovum, is fertilized by a male sperm. The DNA in the head of the sperm enters the ovum, to be combined with the DNA in the nucleus of the ovum.

Men produce sperm in their testes. During sexual stimulation, sperm travel through the vas deferens and are added to the fluids produced by the prostate gland and seminal vesicles, to make semen. Semen is ejaculated through the erect penis into the woman's vagina in order to fertilise an ovum.

Male Reproductive System




Uterus
an expandable, muscular sac that protects and nourishes developing offspring
Fallopian tubes
bring the ovum to the uterus and sperm to the ovum; this is where fertilisation usually occurs
Ovaries
contain the ova, one of which is released during each menstrual cycle; they also produce hormones
Cervix
the mouth of the uterus; also produces mucus to assist in fertilisation
Vagina
the passage from the uterus through which childbirth occurs; menstrual blood is discharged through the vagina; copulation occurs when the penis enters the vagina

HOW TO USE THIS BOOK

This is a reference book. Use it to help find answers to your questions about the human body.

For example, here are some questions. Use the Table of Contents and the Index to look for information and pictures in the book that will help you to think of the answers.

(1) How many vertebrae do you have?

(2) Name a few different ways your body can get dehydrated.

(3) Which muscles lie outside the rib cage?

(4) Which muscles lie inside the rib cage?

(5) Is the urinary bladder in front of or behind the uterus?

(6) When a mosquito bites you, why do you get a red swelling?

(7) Which organs come in pairs?

(8) Which muscles do not come in pairs?

(9) What are glial cells?

(10) Inhaling smoke has an immediate effect on the brain. Trace the path of cigarette smoke in the body, and explain how it can affect the brain.

(11) Why does sitting under a fan make you feel cooler? If you place a plastic chair under a fan, will the chair also get cooler? If you place a running computer under a fan, will the computer get cooler? Compare and explain what happens in each case.

(12) Through which organs, body systems, and parts of body systems does a nutrient pass from the time it enters your mouth until it reaches your big toe?

(13) Name some components of the central nervous system (CNS).

(14) Name some components of the peripheral nervous system.

(15) What is oestrogen and what is its function?

(16) How does the muscular system change over a period of: (a) seconds? (b) hours? (c) weeks? (d) years?

(17) How does the endocrine system change over a period of: (a) seconds? (b) hours? (c) weeks? (d) years?

(18) Which parts of your body send electrical signals?

(19) How can it be that a very tired, worn out old woman can suddenly get enough energy to get up and run to shelter when she sees an airplane coming to drop bombs on her village?

(20) What makes the AR valves open?

(21) What problems might you have if there is something wrong with the functioning of your cerebellum?

(22) List the different kinds of fluids in the human body. What are the similarities and differences between them?

(23) What are some reasons why a woman may not get pregnant even though semen has been deposited in her vagina?

(24) Which parts of your body contain the most lymph nodes?

(25) When the bottom of your heart contracts, does this push blood into the top of your heart? Explain why or why not.

(26) List 20-30 ways in which your body is bilaterally symmetric. Speculate on possible reasons why it has this symmetry.

(27) List 20-30 ways in which your body is not bilaterally symmetric.

(28) List similarities and difference between the ovaries and the testes.

(29) Which abdominal organs lie above the waist, which lie below the waist, and which cross the waist?

(30) What would happen if the bronchioles were not lined with mucus membranes?

(31) Why do people say you should not eat too quickly? What happens if you do not thoroughly chew your food?

(32) How do the reproductive and endocrine systems interact?

(33) How do the respiratory and circulatory systems interact?

(34) What would happen if the length of the small intestine was decreased?

(35) A brain transplant has never been done. What would happen if it was done?

(36) Why might a woman stop menstruating?

(37) Why are your faeces more solid when you are constipated?

(38) What are the sensory signals that the person is getting in the top left-hand picture on page 16?

(39) What is the connection between the lymphatic system and the circulatory system?

(40) List 6 to 10 factors that influence the shape and size of a person's stomach.

(41) What might happen if the semilunal valves leak?

(42) Why do lymph glands get swollen when you catch a cold?

(43) Why do you get a sour taste in your mouth after vomiting

(44) Meghna and Farhaz both weigh 65 kg, but Farhaz is 75% water and Meghna is 65% water. What could be some reasons for this difference?

(45) Name some nerves that are named for the bones they pass by.

(46) If your liver is not functioning properly, what kinds of foods should you eat less of?

(47) Trace the journey of a carbon dioxide molecule from a cell in your little finger out your body through your nose.

(48) What are the differences between the female and male human body?

(49) In what ways could the human body be improved (if it was actually possible to 'redesign' the human body)?

(50) Write some more questions like these that can be answered by referring to this book.

(51) Write some important questions about the human body that are not answered in this book.

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